

OSTEOLOGICAL ANALYSIS OF THE HUMAN SKELETAL REMAINS FROM THE FILOLI SITE, SAN MATEO COUNTY, CALIFORNIA (CA-SMA-125)

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The Filoli site (CA-SMA-125) is a Native American village and cemetery site dating to approximately A.D. 1000. From January 2003 to June 2004 personnel at San Francisco State University completed a NAGPRA compliance inventory on the remains from this site for the San Mateo Community College District. During the course of the inventory, standard observations were made on the human remains according to the guidelines of Buikstra and Ubelaker (1994). Examination of the human skeletal remains recovered from the Filoli Site revealed a number of unexpected results. Some of the most significant findings are discussed below.

One of the notable features of the demography for this site is the very unusual sex ratio. Males constitute 84.6% (22/26) of the sample for which sex could be ascertained. Galloway (1976) attributed the disparity to differential burial practices for males and females at the Filoli Site. He points to the fact that all of the female burials at the site were cremations while none of the cremations were male. This observation is correct however it does not account for the considerable difference in sex representation at this site. There was an enormous quantity of material recovered from the site and despite the poor record keeping, the excavators meticulously collected even the smallest of bone fragments. It is therefore expected that the number of female burials encountered would have been considerably higher even if the cremations were complete enough to substantially reduce the skeleton. A more cogent explanation for the disparate sex ratio at Filoli is that the most of the females for the site were not included in the mound at all but were buried elsewhere. This of course raises the question of why the four females that were buried in the mound were buried with the males rather than with the other females for the site. This question will be addressed with the analysis of age distribution at the site.

Examination of the age-at-death distribution indicated in Figure 1 reveals that the sample from this site has a very unusual age distribution. Considering only the adults, more than 81% (18/22) of the sample is 35 or older and 50% (11/22) is older than 40. Considering the entire sample (subadults and adults) more than 57% (32/56) of the individuals are 2 years of age or less. Compared with the population sample from CA-ALA-328 (Ryan 1971) this is a stark contrast. At CA-ALA-328 32.4% (114/352) of the sample was less than 10 years of age and none of the sample was greater than 40. A

comparison with three contemporaneous Native American populations from the southeast U.S. further illustrates the major difference in age structure at the Filoli Site. An examination of the mortality profiles for these prehistoric sites in Figure 1 reveals some of the unusual characteristics for the Filoli sample. Ironically, while the Filoli sample has the highest percentage of individuals in the youngest age category it also has the highest frequency of individuals in the oldest age category. The most likely explanation for this seeming paradox can be derived by examining the sex ratio for this site. The sex ratio, as discussed above, is unusual in the statistically significant overrepresentation of males. The interpretation for this disparity offered above is that most of the females from the Filoli Site were interred elsewhere. The female cremations that were included in the mound then take on special significance. Examination of the mortality profiles in Figure 1 reveals one possible explanation. While the mortality profile for the Filoli Site is different from any of the others, it most closely resembles the profile for the four Algonquian ossuaries. This is important because one interpretation of the Algonquian ossuaries of the North Carolina coast is that they were the burial place of the village elite (Phelps 1983). Similarly, the older age structure and certainly the elaborate nature and sheer quantity of ritually significant cultural items observed at the Filoli site could indicate an elite burial ground. If this is the case, the females included would certainly be elite members of the group. The fact that the two females for which age-at-death could be assessed were older individuals (40 and 44) lends some support for this hypothesis.

The importance of examining the occurrence and frequency of pathological conditions in skeletal populations is that it can offer insight regarding health status and lifeways of past populations. Most of the pathological conditions that are recorded in skeletal populations record diseases that individuals are living with rather than dying from. Many pathological conditions then actually represent the successful response to disease rather than an indication of poor health. On the other hand, many of these conditions certainly contribute to morbidity although they may not be the proximate cause of death.

There are a number of informative pathological conditions present in this population sample. Most do offer some insight into the general health characteristics of this population; many give information about activity patterns in

this sample; and some may also provide information about genetic relationships in this group. The pathological conditions represented here which yield the most useful information are dental hypoplasias, degenerative joint disease, and abnormal osseous coalition.

A severe metabolic stress, such as a period of starvation or acute illness, during childhood will cause the enamel producing cells (ameloblasts) to cease activity until the stress is removed. This results in a visually obvious line of enamel deficiency across the developed tooth. The age at which the person experienced this metabolic stress may be determined by using a calcification chart (Goodman et al. 1980). Hypoplastic enamel is evident on 19.5% (51/262) of the teeth that could be observed. It is important to note that only five individuals are represented by the teeth that exhibit hypoplastic enamel. Using the method of Goodman and others (1980), the locations of the hypoplastic defects in relation to the cemento-enamel junction indicate non-specific episodic stress occurred in these individuals between the ages of 6 months and 5 years. Enamel hypoplasias are particularly common for this particular tooth and for this age range (Rose et al. 1985). The likely reason for this is dietary deficiency resulting from weaning and/or exposure to “childhood” diseases which commonly strike during this age range. In Figure 2 the frequencies of enamel hypoplasias in the Filoli sample are compared with two populations from the Georgia coast (Hutchinson and Larsen 2001), one agricultural sample and the other a hunter/gatherer sample. Examining the data presented in Figure 2 it can be seen that the hypoplasia frequencies for the Filoli sample are quite low even for a hunter/gatherer population, which in general experience lower early childhood stress levels than agricultural ones. In this regard, it appears that though the Filoli population was experiencing stress during the early years of childhood, it was not affecting all individuals in the population.

Osteological analysis of degenerative diseases has been of particular importance in the examination of past human lifeways (Jurmain 1977, 1980, Merbs 1983, Kilgore 1984, Kelley and Angel 1987). Certainly one of the oldest diseases afflicting humans, degenerative joint disease is one of the most commonly encountered in archaeological populations

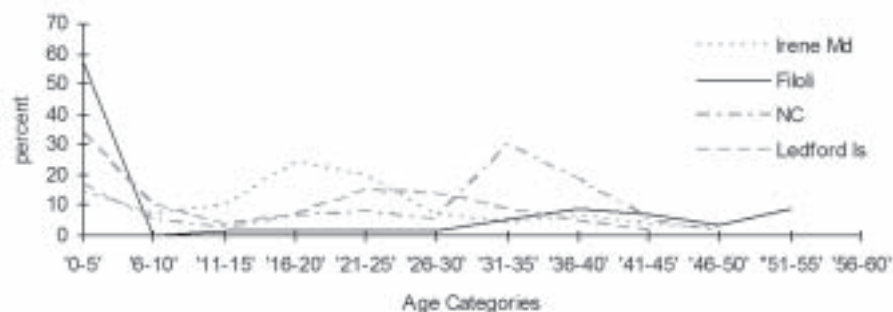


Figure 1: Mortality curves for the Filoli site and three comparative population samples.

(Jurmain 1977). The term “degenerative joint disease” is used in the recent paleopathological literature rather than the formerly used term “arthritis.” The reason for this is that the clinical term “arthritis” refers to inflammation of the joints, a soft tissue condition, which cannot usually be demonstrated in skeletal tissue. Degenerative joint disease is an age-related, progressive disorder involving destruction of articular cartilage and subsequent joint alterations. Although a variety of factors influence the disease process, level and type of mechanical demand may be particularly important (Jurmain 1977, Merbs 1983). Skeletal changes include loss of bone on joint surfaces and formation of new bone along joint margins.

Degenerative joint disease can be seen to varying degrees in the majority (13 of 18 individuals or 72.2%) of the complete adult burials. The severity of the degenerative changes ranged from minor marginal lipping to complete loss of articular cartilage and subsequent severe eburnation of the knee joint in one individual. All thirteen individuals that exhibited degenerative joint changes had involvement of some section of the vertebral column. Six (46.1%) of these individuals also had involvement in another joint outside of the vertebral column. A comparison with two Guale population samples from coastal Georgia (Larsen et al. 1996) puts this level of degenerative joint disease in perspective.

Examination of the frequencies of degenerative joint disease reported in Figure 3 reveals the nature of differences in the Filoli sample. For most of the examined joints the Filoli sample has the highest frequency of degenerative changes for the three population samples. This difference in frequency is most notable in the vertebral column. The Filoli sample has a frequency of degenerative changes that is

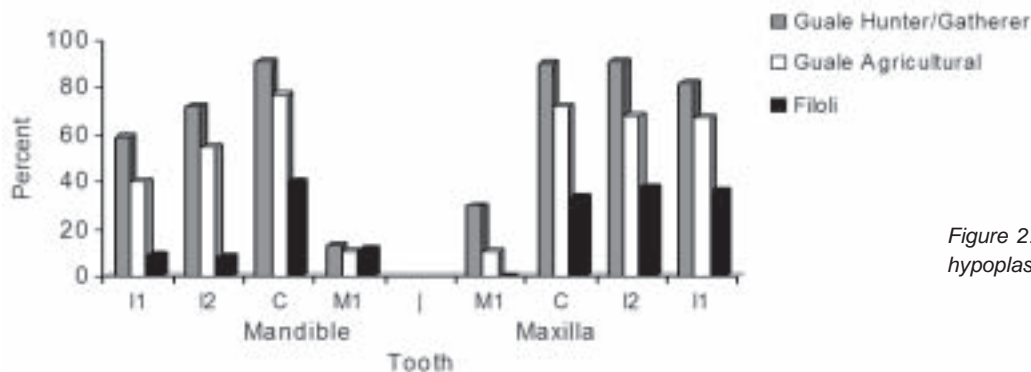


Figure 2: Frequencies of enamel hypoplasia in three population samples.

nearly twice as high as the higher of the two comparative samples. The concentration of degenerative changes predominantly in the vertebral column and lower body may indicate a higher level of chronic mechanical load in this portion of the body. This would be consistent with carrying heavy loads on foot over long distances.

Spondyloarthropathy is a “subset of arthritis, characterized by erosive joint disease, ossification of sites of tendon, ligament, and joint capsule insertion (enthesial bone formation), and a tendency to spine and sacroiliac fusion” (Rothschild and Woods 1991; Resnick and Niwayama 1995). Although it is arthritic in nature, it departs from many of the rheumatic conditions in that it typically manifests well before the age of 35 (average age of onset is 26).

Modern patients diagnosed with spondyloarthropathy frequently have a number of factors in common. The majority (>75%) of patients diagnosed with spondyloarthropathy carry the HLA-B27 gene. The HLA-B27 gene is a gene found in the Human Leukocyte Antigen complex. The HLA complex controls inherited immunity to diseases. The HLA-B27 gene is a perfectly normal variant found in about 8% of the general population. No more than 2% of people who inherit the HLA-B27 gene will contract a spondyloarthropathy. The gene itself does not cause the disease, but combined with other contributory factors, it increases the liability to spondyloarthropathy. The second factor is that of sex. Many of the spondyloarthropathies occur far more frequently in males than in females. About 90% of the cases of ankylosing spondylitis and Reiter’s syndrome are male (Aufderheide and Rodríguez-Martin 1998). Lastly, similar to rheumatoid arthritis, many of the spondyloarthropathies seem to have an infectious or autoimmune precipitating event. The inflammatory autoimmune skin disease known as psoriasis is frequently followed many years later by the manifestation of psoriatic arthritis. Reiter’s syndrome is found in patients following an infection generally either in the genitourinary tract from sexual contact or in the gastrointestinal tract from contact with contaminated food. One in five patients diagnosed with inflammatory bowel disease (ulcerative colitis and Crohn’s disease) will develop spondylitis of inflammatory bowel disease. The connection between each of the diseases above and spondyloarthropathy is unclear. However each of the above diseases combined with the presence of HLA-B27 seem to precipitate later degenerative changes in specific joints.

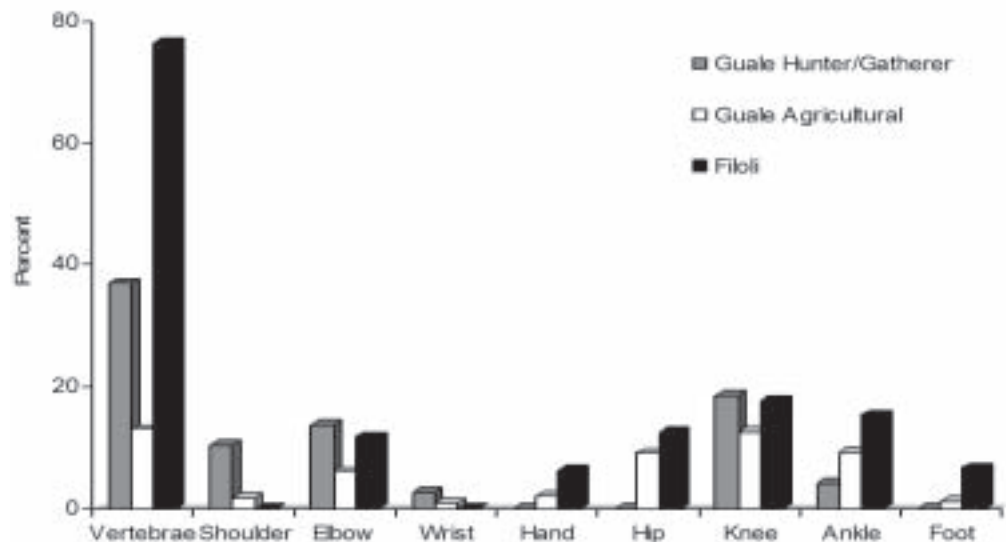
The majority (10 of 17; 58.8%) of the complete individuals from the numbered burials in this population sample exhibit a pattern of joint changes that resembles spondyloarthropathy.

The degenerative changes are localized to: (1) the joint capsule margin near the greater trochanter of the humerus, (2) the scapular articulation of the clavicle, (3) and the articular surface of the acromian process of the scapula. The joint alterations primarily involve focal pitting surrounding the joint capsule in the large synovial joints (proximal humerus) and subchondral erosions on the articular surfaces of the cartilaginous joints (clavicle and scapula). Of the individuals that exhibit these pathological alterations, 100% have involvement of the clavicle and 80% (8 of 10) have involvement of the humerus or scapula. For 80% of the individuals the joint alterations are bilateral.

Tarsal-metatarsal coalition is an abnormal union of two bony elements of the foot. The union may be complete or incomplete and can be bony, cartilaginous, or fibrous (Bohne 2001). Tarsal coalitions are most common in males rather than females. Tarsal and tarsal-metatarsal coalitions are likely congenital (Rothschild 2004). Genetic research has suggested that tarsal coalitions are inherited as an autosomal dominant trait with almost complete penetrance (Leonard 1974, Newman and Newberg 2000, Stornont and Peterson 1983). Most researchers report an incidence of 1% or less. Among the complete numbered burials, 6 of 17 adult individuals (35.3%) exhibit fibrous tarsal-metatarsal coalition between the 3rd cuneiform and the 3rd metatarsal. This is an extraordinary incidence. Considering the congenital nature of this condition the observed incidence of tarsal-metatarsal coalition here suggests a close genetic relationship among these individuals.

In conclusion, the human skeletal material recovered from the Filoli Site provides a considerable amount of information about the original inhabitants. Of particular interest is the unusual age distribution for the site. Considering only the adults, more than 81% of the sample is 35 or older and 50% is older than 40. Considering the entire sample (subadults and adults) more than 57% of the individuals are 2 years of age or less. The most probable

Figure 3: Degenerative joint disease frequencies in three populations.



explanation for this very unusual distribution is differential burial. This sample likely only represents the older elite males, elite females, and children generally under the age of 3 years. The rest of the population was likely buried elsewhere.

The examination of pathological conditions reveals an overall healthy population and also lends some support for the aforementioned hypothesis. While there were a considerable number of identifiable pathological conditions present on the remains, the overall picture suggests a relatively healthy population. This conclusion can be reached because most of the pathological conditions either indicate complete recovery (e.g., dental hypoplasia from episodic stress early in life and healed porotic hyperostosis) or are considered to be a disease of advanced age (osteoarthritis). Two important conditions present are spondyloarthropathy and tarsal-metatarsal coalition. The importance of these two conditions lies not in their relative gauge of health for the population but rather in their indication that the individuals that exhibited these conditions were probably closely related to one another. This lends some support to the hypothesis that this was a burial ground for the elite. Equally important is the observation that some of the pathological conditions (degenerative joint disease and spondylolysis) indicate a population that was performing consistently strenuous activity.

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